Solid foodstuff supplemented with phenolics from pomegranate wastes by ultrasound-assisted osmotic treatment

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In recent years, industrial and consumer interests have focused on developing foods supplemented with physiologically active components that provide greater physiological benefits. Osmotic treatment (OT) is widely used to modify the composition of solid foods (e.g. fruits, vegetables, meat, and fish) by partially removing water and adding solutes (Rastogi et al., 2002). Even though OT has been extensively used to produce intermediate moisture products, it has only been used to a limited extent to produce functional foods from fruits and vegetables. In particular, it has been used to impregnate plant foods with probiotics and minerals (e.g., calcium and zinc). Recently, OT was described as being a suitable method for infusing solid foodstuffs with grape phenolics (Rózek et al., 2007).

However, the rate of mass transfer during osmotic dehydration is generally low. A number of pretreatments such as high pressure, pulsed electrical field, partial vacuum, and centrifugal force are reported to enhance the rate. The ultrasound in combination with osmotic dehydration results in higher rate of water loss and solute gain due to increased cell wall permeability owing to the formation of microscopic channels, which facilitated the transport of water and solute (Nowacka et al., 2014).

Pomegranate (*Punica granatum* L.) is one of the oldest known edible fruit that contains the highest concentration of total polyphenols in comparison with other fruits studied. The main uses of pomegranates in food industries include fresh juice or pomegranate-based drinks. Since the juice yield of pomegranates is less half of the fruit weight, very large amounts of by-product wastes, such as peels, are formed every year. Pomegranate by-product wastes have been traditionally valorised as animal feed. Recently, the peels of pomegranate were introduced as a rich source of antioxidants and phenolics (Kim et al., 2002). So far, the use they have been put to in the development of food products of high nutritional value has been limited to that of supplementing confections, fruit fillings, sauces, beverages, and pasta products, but there has been no report of them being used to infuse fresh solid foodstuffs.

The development of new and improved processed products from potato appears to represent an excellent means of increasing the utilization of this high yielding and nutritious species. Osmotically dehydrated potato can be used as a quick-cooking product or as an ingredient in salads and soup mixes. In this work, osmotic dehydration was assessed as an operation for supplementing potato with pomegranate peel phenolics to increase its antioxidant properties. The aims of the present work are (i) to study the rate of phenolics infusion into potato cubes during osmotic dehydration, (ii) to determine the diffusion coefficients of water, solute as well as phenolics during the treatments, and (iii) to evaluate the possible enhancement of mass transfer during osmotic dehydration due to application of ultrasound treatment.

Experiments with ultrasound application were carried out without stirring the solution using a probe system. Potato cube samples were placed in a basket consisted of shelves and immersed in the osmotic solution in a beaker where the ultrasonic probe horn was immersed. To investigate how the nature of osmoactive solutes affects mass transfer of pomegranate peel phenolics, sodium chloride and maltodextrin (12 DE) were used as osmoactive solutes. The cubes were treated with different osmotic solution concentrations under different temperatures for different times (30, 60, 120, 180, 240, and 300 min). Mass transfer of total pomegranate peel phenolics were characterized by the diffusional approach and Peleg's model.

Ultrasound treatment resulted in higher moisture and solid mass transfer due to the breaking of cell structure as revealed by microstructure examination. The present study concluded that osmotic dehydration is a feasible technology for impregnation of functional ingredients into foods.

References

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